

## INTRADURAL TUMOR OF THE CERVICAL MENINGES.

WITH EARLY RESTORATION OF FUNCTION IN THE CORD AFTER REMOVAL OF  
THE TUMOR.

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*(From the Surgical Service of Dr. Halsted.)*

THE following case adds one more to the recorded instances of operative removal of an intradural spinal tumor. From a critical stand-point, namely, that of complete extirpation of an enucleable growth, not only without augmentation of pre-existing pressure symptoms from operative trauma, but also with a subsequent and seemingly complete restitution of the normal physiological integrity of the cord, the number of these cases has been exceedingly limited. An interval of over ten years elapsed after Gowers and Horsley's brilliant demonstration of the feasibility of such surgical procedures before any correspondingly successful case was recorded; and this, in spite of the evidence, from statistical studies made in the interim, that a large proportion of the subdural tumors found at autopsy remain non-infiltrating and enucleable even in the advanced stage at which they have been more or less directly the occasion of death.

Earlier diagnosis, more exact methods of segmental localization and more frequent laminectomies for exploratory purposes in doubtful condition, now that the procedure has come to be regarded as one relatively free from danger, happily are combining to increase the number of these most gratifying operations. Within the past few years there have been reported four or five cases which serve to indicate what may be expected in the near future. One of them, most carefully described by

Henschen and Lennander, is in almost every detail, in symptomatology, segmental situation, pathological characteristics of the growth and operative result, the exact counterpart of that which it is my privilege here to record: a needless task, therefore, were it not for the comparative rarity of these cases and the desirability of accumulating evidence concerning them.

Due to the early and unequivocal diagnosis made after the patient's admission to Dr. Osler's service,\* and his prompt transference for operation without the customary period of temporizing with antiluetic treatment, the case seems in many respects the most satisfactory of any heretofore recorded. A few months more of compression doubtless would have left the cord in a condition from which functional restoration, though possible as other cases have demonstrated, nevertheless would have been much less rapid. Practically, normal function was regained by Gowers and Horsley's patient, though at the time of operation he had become completely paraplegic. Eskridge and Freeman's case was almost as far advanced: the symptoms in Henschen and Lennander's patient had progressed considerably beyond those present in our case. The rapidity of functional recovery in the compressed cord, as well as its completeness, has naturally been inversely proportionate to the extent and duration of the pressure exerted upon it. In some of the cases of successful removal of a meningeal tumor, a temporary increase in pressure symptoms has been occasioned by the operation, with a consequent retardation of the physiological recovery. A few have been reported before restoration was complete, though it promised to be largely so. In one or two instances there has been little, if any, postoperative diminution whatever in the pre-existing paralyses. The great desideratum in this, as in any surgical procedure, is not only

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\* *Note by Dr. Osler.*—"When the patient first consulted me I suspected cervical caries or pachymeningitis. It was not until after his admission to the hospital, and a more careful study of the case with Dr. H. M. Thomas, that tumor was suspected. I urged early operation, feeling sure that the condition would not be made worse."

to alleviate suffering, but if possible to restore the patient's "Arbeitsfähigkeit," as it is expressed by the Germans.

*Surgical No. 15,414. Intradural Fibrosarcoma of the Spinal Meninges opposite the Sixth, Seventh, and Eighth Cervical Segments. Laminectomy with Enucleation of Growth and Closure of Wound without Drainage. Uneventful Convalescence. Rapid and Complete Recovery.*

The patient, L. H., aged thirty years, the son of a Russian immigrant, entered Dr. Osler's service October 14, 1903, complaining of "pain in his shoulder and of awkwardness in his gait."

*Family History.*—His parents are living and well; also a brother and three sisters. One sister died in childhood. No family record of tuberculous, tumor, rheumatism, or gout. No other instance of paralysis in the family.

*Personal History.*—The patient had measles when ten years of age, and later some fever which kept him in bed a few weeks. No knowledge of scarlet fever, malaria, pneumonia, typhoid, or influenza. "Has always been healthy." He denies venereal infection and there is no history suggestive of lues. He has been moderate in the use of tobacco and alcohol and regular in his habits. For ten years he has worked as a clerk in a wholesale dry-goods house. His usual weight is 132 pounds. He has been married seven years and has two children living and well. His wife, a delicate woman, has had three miscarriages, one at three and two at seven months. She has never had any other illnesses to his knowledge.

*Present Illness.*—Eighteen months ago (July, 1902), when otherwise in good health, the patient began to have pain in the flexor surface of his left forearm. It increased in severity during the succeeding months, extended into the region of the left shoulder and upper part of the back, and was often so severe that he was unable to sleep. Movements of the neck aggravated his discomforts to such an extent that he had to be helped out of bed every morning. On assuming the erect posture and moving about for a time, "limbering up," he could manage to go to work for the day. After a few months the pain became less acute and he was much less incapacitated by it, although he had constantly to guard himself against making any sudden movement of his

neck. Almost from the first he has noticed that sneezing, laughing heartily, yawning, or coughing would cause pain to shoot from his shoulder out into the arm, a symptom which has persisted to the present time.

This condition of things continued without especial change during the remainder of the year. Early in 1903, he does not remember exactly when, a burning sensation in the right and some weakness of the left leg was first noticed. He kept at work at this time, although his movements were necessarily slow and deliberate, and there was some dragging of the left foot, with especial difficulty in mounting stairs. There were no pains in the lower extremities. On arising in the morning a sensation of "stiffness" and inability to use his legs would invariably be present, but would wear off after exertion. For some time past he has observed a "wasting" (atrophic) condition in the muscles of the left hand, but has used it so little, owing to the pain in the arm, that he seems unaware of any especial weakness. He has noticed also that alterations in surface temperature, when in a warm bath, for example, or when his feet are in contact with a cold floor, are less easily recognized on the right than the left side.

In August, 1903, he was in bed for ten days with a high fever, supposed to be typhoid. Since then his symptoms have become somewhat aggravated and he has not returned to work. He has been very constipated of late, and there is some unaccustomed hesitancy in evacuating the contents of his bladder. No disturbance of the sexual functions has been observed.

*Physical Examination.*—A well-nourished, sallow-complexioned young man. Mucous membranes of good color, no jaundice. The tongue is clean and protrudes in the mid-line. No lead line on gums. The teeth are clean and sound. No glandular enlargement or other swelling on the neck. No tracheal tug.

The thorax is well formed and symmetrical. Examination of the heart, respiratory and vascular systems is negative.

The pulse is regular in force and rhythm and of good volume. The blood-pressure in the brachial represents 123 millimetres of Hg.

The abdomen, the genitalia, etc., present nothing noteworthy.

Blood examination. Hæmoglobin, 74 per cent.; red blood-corpuscles, 4,232,000; white blood-corpuscles, 7400.

A tendency to a subnormal temperature was more or less constant. On two occasions, 96° F. (mouth) was recorded.

*Special Examination.*—The left pupil is slightly smaller than the right. Both react equally well to light, directly and consensually, and accommodate for distance. There is no apparent difference in the width of the palpebral clefts; no vasomotor disturbances in the face. There is no paralysis of any of the cranial nerves.

The patient is quite round-shouldered, naturally so, but in addition carries his neck somewhat stiffly bent forward. There is no thickening or especial prominence of the cervicodorsal spines; no particular tenderness; no muscle spasm; no great limitation of motion; hyperextension is possible to a considerable degree. Passive flexion of the neck is, however, strongly resisted. Active movements on the part of the patient seem more apt to cause pain than passive ones. Pharyngeal palpation of the vertebral bodies is negative. There is a slight convex curve, not exceeding normal limits, however, of the dorsal spines to the right side.

The patient stands without great difficulty but with some unsteadiness, especially when the eyes are closed. He cannot stand upon his heels, nor can he rhythmically tap the ball of either foot upon the floor. He tires quickly, and after standing for a time there is a marked tremor in the muscles of the left leg. He uses this leg very awkwardly in walking. He has considerable difficulty in standing on either foot alone.

The *subjective pains* radiate into the left arm and down as far as the wrist without definite localization; they also shoot into the posterior triangle of the neck. They are paroxysmal and occasioned by any straining effort, sneezing, coughing, or by any sudden movement. They are at present not particularly severe. A burning sensation has been present in the right leg almost from the onset. There are no areas of hyperæsthesia.

*Motor Disturbances.*—None are apparent on the right side of the body. On the left there is a marked atrophy of the intrinsic muscles of the hand, with wasting of the thenar and hypothenar eminences, as well as of the intermetacarpal spaces. The fingers of this hand can barely be separated and the grasp is very feeble. Weakness of the extensors and flexors of the fingers and of the flexors of wrist is also marked; less so in the wrist extensors. The flexors of the elbow with supinators and pronators of the

forearm and the triceps are also weak when compared with the sound side. The movements of the shoulder are performed with equal strength on the two sides, though the costal portion of the pectoral and latissimus dorsi contract less powerfully on the left than right.

Below the level of supply by the first thoracic segment the entire musculature of the left side of the body seems less strong than on the opposite side. All movements of the lower extremity, especially of the toes and dorsal flexion of the foot, are made only with considerable effort.

Comparative measurements in circumference of the arms.

	Right.	Left.
Upper arm.....	25	22½
Forearm .....	25	23
Hand .....	21	20

The thigh and calf of the left leg are throughout nearly one centimetre smaller in circumference than the right.

*Sensory Disturbances.* (See Charts, Figs. 1 and 2.)

On admission (October 14), examination showed no interference with the transmission of tactile (common sensation) impressions from either side of the body, nor was there an appreciable loss in tactual sensitivity at any subsequent examination. Thermic and pain perception was lost over the entire right side of the body from the level of the second intercostal space. No note was made of any involvement of the postaxial surface of the arm at that time. An examination three weeks later (November 4) showed the upper margin of thermo-anæsthesia and analgesia to have extended to the elbow along the inner surface of the upper arm, and on November 18 it was found to have extended to the forearm and hand according to the diagram. (Figs. 1 and 2.) Posteriorly in the mid-line it reached as high as the spine of the first thoracic vertebra. Some lowering in the acuity of thermic and painful impressions was also to be made out on the left side below the level of the second intercostal space, though the area faded out, without definite boundary, about the level of the fourth rib. No stereognostic difficulty with either hand. No apparent loss of muscle sense in the extremities.

*Reflexes, Deep.*—There is an exaggeration of the deep reflexes at knee and ankle on both sides, and a clonus may be easily elicited, especially on the left side. Exaggerated responses from

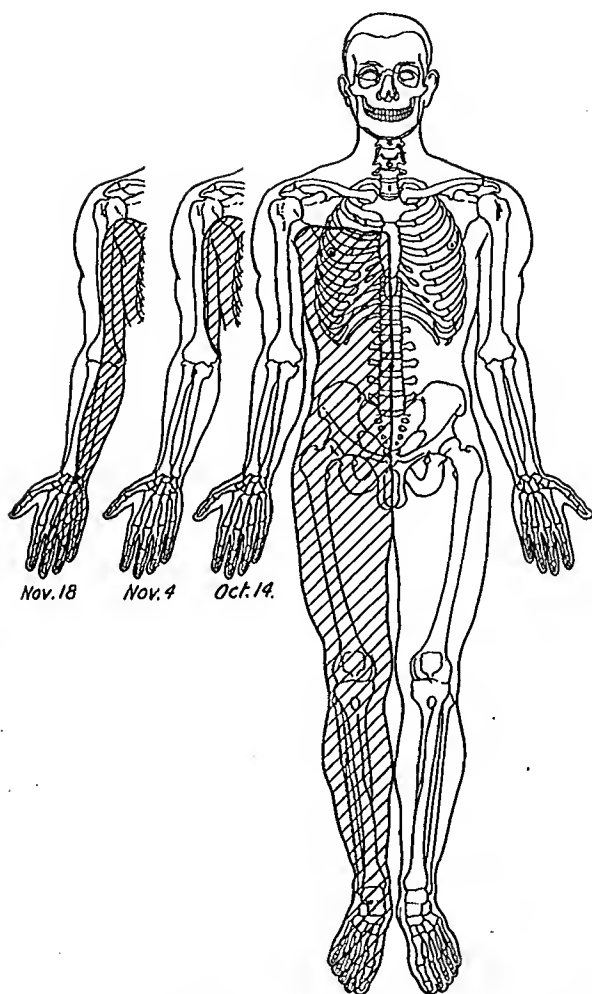


FIG. 1.—Chart of anesthesia, anterior view. Shaded area represents the field of anesthesia to pain and temperature on three successive dates. Some dulling of these sense qualities was present on the left, though with boundaries too indefinite to chart. No appreciable diminution of tactile perception anywhere present.

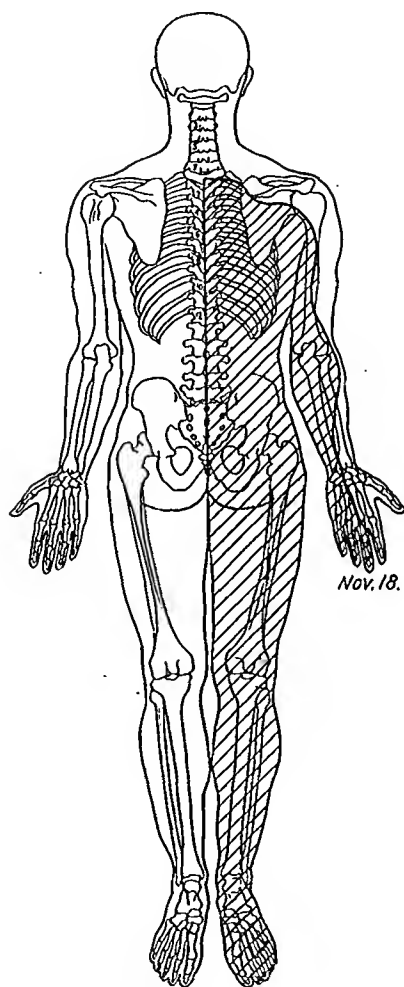


FIG. 2.—Chart of anesthesia, posterior view.



tapping on the biceps tendon and flexor tendons of the wrist are also obtainable in the left arm.

*Superficial.*—Very active responses to plantar stimuli, often with drawing up of the legs, are present on both sides, apparently with a dorsal flexion of the great toe, though not especially characteristic of the Babinsky reflex. The cremasteric response, though sluggish, is obtainable on each side; least inactive on the right. No abdominal or anal (sphincter) reflex could be elicited.

On October 25 tuberculin was administered for diagnostic purposes, without any subsequent reaction.

On October 30 an X-ray plate was taken of the cervicodorsal region. It showed no abnormalities of the spinal vertebrae.

*November 19, 1903. Operation. Ether Anæsthesia.*—The patient was placed on the table, with the arms hanging at the side in order to separate the scapulæ, and with his neck anteflexed. An inflatable pad of Dr. Follis's design, which had been inserted under the neck and thorax, was then blown up so as to make the cervicodorsal spines the most elevated portion of the body.

The laminectomy was performed in the usual manner. A median longitudinal incision was made from the spine of the fourth cervical to the third thoracic vertebra (Fig. 6) and carried down to the bony processes. Care was taken to split all the soft parts, especially the ligamentum nuchæ, in the mid-longitudinal line. The muscles were cut away from the spines and laminae of the exposed vertebrae on each side, and held aside by hot saline compresses and broad retractors. As much of the periosteum as possible was scraped off from the arches. The spines of the two lower cervical and the first thoracic vertebrae were cut away with heavy bone forceps. Some confusion in orientation was occasioned at first by the fact that the fifth cervical, instead of the sixth, was the last bifid spine; the vertebra prominens, however, was sufficiently characteristic to be a reliable landmark. The laminae were then carefully cut away from the three exposed arches.

On removing the fatty covering of the dura, the membrane, about six centimetres of the posterior aspect of which was exposed, was found to be abnormally tense and vascular, with an unusual dilatation of the median posterior vessels. This condition was for the moment thought to be due to the patient's position. It was not until the membrane was carefully opened and

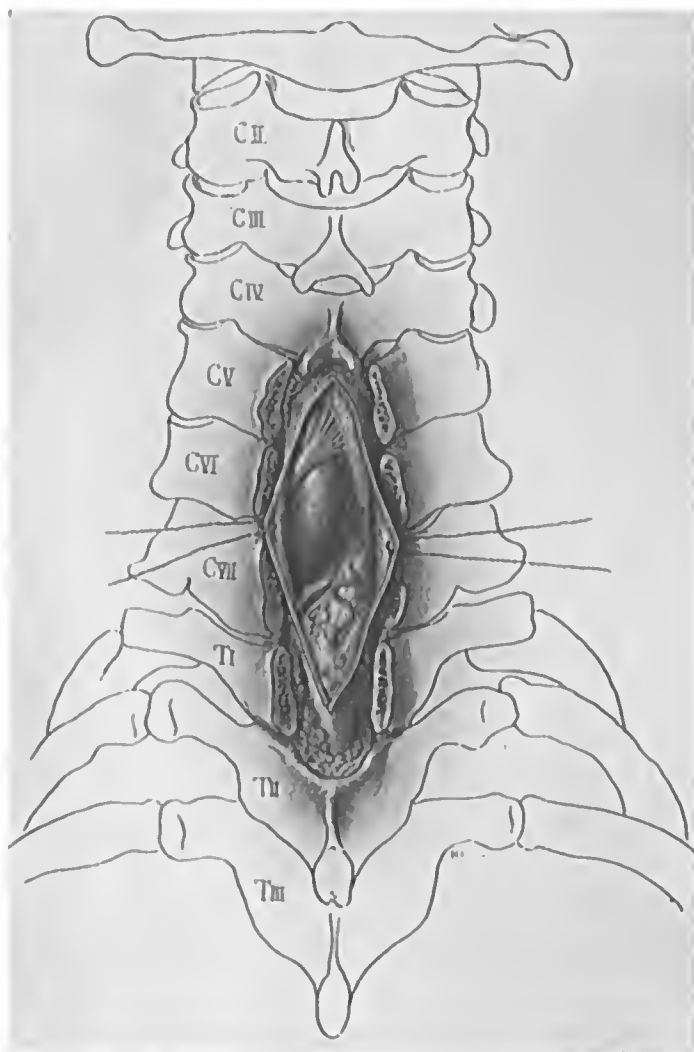


FIG. 4.—Schematic view, from a sketch at the time of operation, of the position of the growth relation to the inclosing vertebrae.



the abnormal amount of fluid contents disclosed, that the true cause of the distention was apparent. Fluid escaped in considerable amount from the subdural space. The dura was then incised the full length allowed by the exposure, and on holding apart the edges of the membrane the thin, transparent arachnoid bulged into the opening like a distending bubble. This was pricked with a knife and the fluid spurted from the opening in jets corresponding with the cardiac and respiratory rhythm. Not until the contents of the subarachnoid space was thus evacuated and the transparent membrane had settled down closely over the cord was it apparent that there was some underlying abnormality. The thin arachnoid was then in its turn incised as far as the wound allowed, and lying on the left side of the cord, perhaps about four-fifths of it exposed, was seen to be an oval-shaped growth of a dusky purplish color. The cord itself was compressed to the right, was somewhat flattened, and much more vascular than usual in its appearance. The pial veins, especially the mid-longitudinal vein, was much congested and very tortuous. At this stage the tumor began to extrude itself into the wound, and by gentle manipulations its lower pole was readily freed and tilted upward. One posterior nerve-root lay across the upper portion of the exposed surface and served to retain the upper pole of the growth in its original position. Division of this root made it possible to liberate the tumor still more, and, although its superior end was hidden under the laminae of the fifth vertebra, it was thought probable that it could be shelled out without removal of this bony arch, which was somewhat difficult of access. Unfortunately, this proved to be impossible, for the tumor was found somewhat adherent laterally to the membranes, and in the process of separating them the soft tumor broke across, leaving its upper third still in position. At this juncture it seemed, after all, advisable, in order to insure a complete extirpation, to remove the laminae of the fifth vertebra. This was done, and the exposure sufficed to bring into view the upper pole of the growth, which was then removed as a separate piece. The accompanying sketch (Fig. 4) serves to show the relative position of the tumor and the neighboring vertebrae.

The manipulation to remove the tumor occasioned from time to time some bleeding, chiefly of a venous character, which was readily controlled by pledgets of sterile absorbent cotton; these

were tucked into the spaces which the tumor had occupied, great care being taken not to traumatize the cord itself. The canal was then irrigated with warm salt solution to wash away the few clinging blood-clots.

The wound was closed in layers; delicate interrupted silk sutures for the dura; a layer of deep silver-wire mattress sutures for the spinal muscles; a second similar layer for the ligamentum nuchæ and aponeurosis of the trapezius; a subcuticular suture for the skin. No drainage was used for the wound. A dressing with a plaster-of-Paris support for the head and neck was applied.

The patient stood the operation remarkably well. No shock whatever was occasioned, nor was the small amount of blood lost sufficient to lower the arterial tension. The blood-pressure chart here reproduced (Fig. 3) shows that the only noteworthy alterations in systolic level were (1) a "pressor" response, which at the time was thought to be due to a slight asphyxiation from the patient's position which made anesthetization somewhat awkward, and (2) a "depressor" response, which occurred at the time of evacuation of the pent-up fluid postaxial to the growth.\*

*Postoperative Notes.*—November 20. "The patient passed an excellent night, sleeping most of the time. He was given one-fourth grain of morphia in the afternoon on recovering from his anæsthetic. Otherwise no narcotics were demanded.

"This morning he is subjectively much more comfortable than before the operation. There are occasional shooting pains in the left arm and a sensation of numbness in the hand, but otherwise no discomfort. The pains are spontaneous; not increased by straining as before.

"His motor condition is much improved. Movements of the left side are perceptibly less weak. The patient is subjectively aware of this. A return of power is especially noticeable in the

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\*The comment has been usually made by those who have operated on these cases that the meninges below the tumor are greatly distended with cerebrospinal fluid (chiefly subarachnoid) under an increased tension, the tumor, as it were, acting as a cork to the spinal flask in which fluid continuously accumulates. A lumbar puncture with measurement of this tension may be of diagnostic value in these cases, and should be undertaken by risk, if no more of the fluid be withdrawn than is necessary for the making of the observation.

FIG. 3.

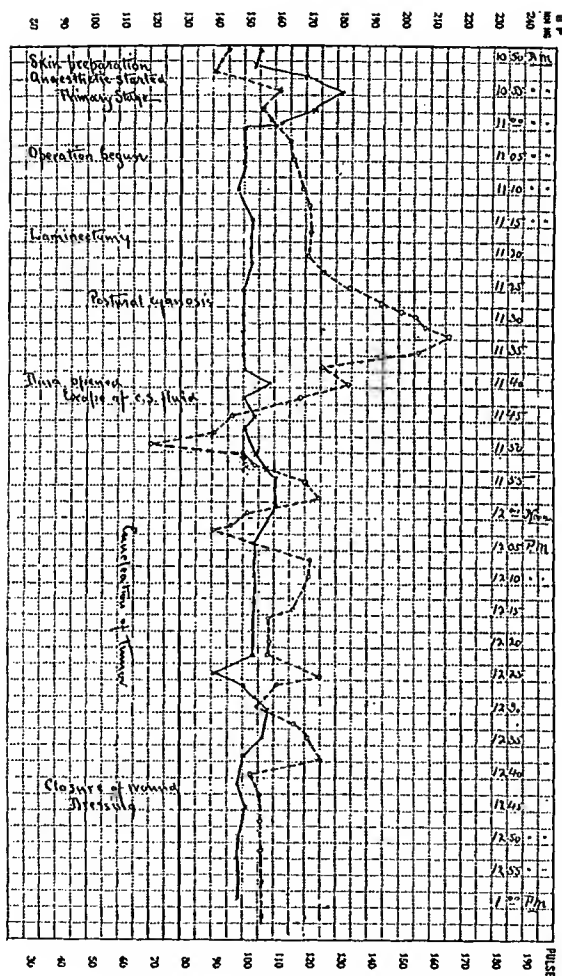


Chart of pulse-rate and blood-pressure during the operation.—Blood-pressure (Riva-Rocci), broken line; pulse-rate, solid line.

Note (1) the comparative regularity of pulse-rate during the operation; (2) the "pressor" response during the laminectomy in spite of the associated loss of blood; (3) the "depressor" response accompanying the escape of cerebrospinal fluid; (4) the absence of evidence of "shock" during or after the procedure.

dorsal flexion of the toes and foot. Even the movements in the wasted hand are stronger. He can now hold his fingers apart with some resistance."

"Considerable diminution is also apparent in the degree of anæsthesia. Over the entire right side, as high as can be examined (the dressing covers the body to the xiphoid level), the patient distinguishes readily between the head and point of a pin. Compared with the left side, however, there remains considerable hypalgesia. The area of lowered perception to pain in the right arm has entirely disappeared.

"Thermo-anæsthesia persists on the right side below the level of the dressing, but, as with pain, there is a return of normal thermic sensitivity in the right arm.

"No sensory disturbance can be detected on the left side below the dressing. No loss of tactual (common) sensitivity anywhere on the body.

"The deep reflexes remain active as before the operation, with the exception that no ankle clonus can be obtained on the right side."

It is unnecessary to detail the results of the subsequent daily examinations, which were painstakingly made by Mr. L. S. Morgan,\* then clinical clerk, and corroborated by other observers. The symptoms as outlined on this first day's examination will be followed one by one until their disappearance.

*Subjective Symptoms.*—Occasional shooting pains were complained of in the left shoulder, arm, and down into the wrist for several days, but with diminishing intensity, and by the tenth day they had disappeared entirely. The "numbness" complained of in the left hand was found on the second day to be associated with some hyperæsthesia, the area not having any very definite boundary, the pins-and-needles sensations being perhaps more marked in the middle and index fingers than in the others (Fig. 5.) The sensation of burning in the right leg and the pains occa-

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\*In addition to Mr. Morgan's records, I am much indebted for many of the details of this history to the notes made by Dr. McCrae, Dr. Hirschfelder, and Mr. Edwards, the clinical clerk of this case during his residence in Dr. Osler's wards, and also to Dr. Geraghty and Mr. Morgan who cared for him after his transfer to the surgical side.

sioned by laughing, coughing, sneezing, etc., were never felt after the operation.

*Motor Symptoms.*—The considerable improvement noted the day after operation gave promise of the rapid return of motor function; tests for the foot and leg on the third day, November 22, failed to show any difference in strength on the two sides. On the ninth day, when unobserved, he got up out of bed and walked the length of the ward to the patients' bathroom and back. He was up in a wheel-chair on the tenth day, was allowed to walk about on the following, and an examination on December 7 (eighteen days) failed to disclose any difference in the motor activity of the two legs. No lameness or hesitation whatever was apparent in his gait; his movements were active, and there was no subjective sensation of disability whatever.

The left arm and hand, although they regained their normal strength somewhat less rapidly than the leg, continued to improve without interruption. The strength on the two sides was about equal at the time of the patient's discharge; the measurement of the arm showed that it was filling out and the atrophied muscles were visibly increasing in size.

*Sensory Symptoms.*—As recorded, the anesthesia to thermic and painful stimuli in the right arm had entirely disappeared by the day after operation. On the right side of the body and leg the analgesia in twenty-four hours had so diminished that painful impressions, though dulled, were everywhere appreciated as such, and the difference between the head and point of a pin was recognized promptly. By the eighteenth day no difference in the acuity of pain perception was recognizable between the two sides, except for one patch on the inner aspect of the leg below the knee where pain seemed to the patient to remain somewhat dulled.

On the third day, for the first time, was the patient able to distinguish on the right side between heat and cold (though the sensation was not "natural") over the body and leg as low as the knee. By the eighth day (November 27) only the foot remained anesthetic to thermic impressions. By the seventeenth day the slightest differences in temperature were appreciable everywhere over the right leg, with little if any disparity between the two sides of the body.

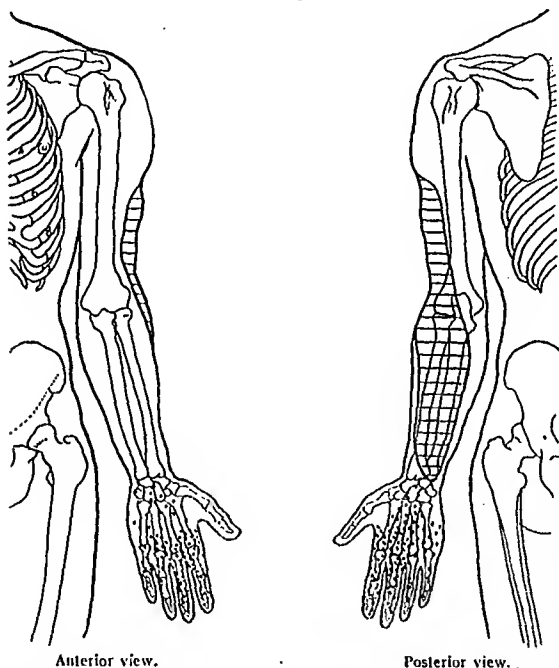
*Postoperative Sensory Disturbances in Left Arm consequent upon Root Division.*—The only increment in symptoms of any



Macaeuqe as indicated by Sherrington and in a certain degree with Head's CVII area. It would possibly be included in Kocher's CV and in Wichmann's CV and VI territories.

In addition to this field of dissociative anaesthesia, sensory disturbances of a hyperaesthetic character, but without any dull-

FIG. 5.



Transient postoperative area of dissociative anaesthesia in left arm due to posterior root division. Dotted area of hyperaesthesia; shaded area of diminished perception of pain and thermic stimuli.

ing of sense perception, were present in the hand. To this the patient had called attention immediately after the operation as an unpleasant "numbness and tingling,"—a "pins-and-needles" sensation,—which was much increased by touching the part. It was most marked in the index and middle fingers, did not include the thumb, and shaded off as indicated in Fig. 5. Evidences

of vasomotor disturbance were present at the same time, the hand being much warmer than the other and constantly moist. This condition of hyperæsthesia persisted for several weeks, much longer than the disturbances in the anæsthetic area, its final disappearance taking place about the third month with a gradual subsidence. It persisted longest in the index finger. The area involved was taken to represent the field of the adjoining post-axial nerve-root, or possibly to represent the zone of overlap with this neighboring field. It is a common observation to find, after a peripheral neurectomy in man, a hypersensitive strip delineating the anæsthetic field, and experimental investigations have demonstrated the presence of such hyperæsthetic boundaries for the anæsthetic field after the division of the dorsal nerve-roots.

*Reflexes.*—The deep reflexes at the knee and ankle rapidly diminished in activity, especially upon the right side, where ankle clonus, easily elicited before, could not be brought out after the operation.

The unduly active response to plantar stimuli soon disappeared, and was replaced by an inactive state, in which no movements whatever in the toes or ankles could be brought out by stroking the sole. Normal cremasteric, anal, and abdominal reflexes equal on the two sides was obtainable by the third week.

At the examination three months after the operation the only residual of the patient's former symptoms lay in the slightly increased activity of the deep reflexes. It was unassociated with any spasticity, however. He could stand easily on the toes or heels, and while balancing on either foot could rapidly tap the toes of the opposite one on the floor.

*Healing of Wound.*—The plaster dressing was removed for the first time on the ninth day (November 28), when the silver subcuticular suture was removed and a collodion strip applied without other support. The healing was absolutely without visible reaction. The photograph (Fig. 6) was taken on the fourteenth day, the patient being up and dressed at that time. He was discharged on December 16, four weeks after the operation, to all appearances perfectly well. The only evidence of any pre-existing trouble being in the slight wasting of the muscles of the left hand, which had, however, increased greatly in strength, in the active deep reflexes, and in the slight hyperæsthesia remaining in the index and middle fingers of the left hand.



FIG. 6.—Photograph fourteen days after the operation. The wound, which is barely perceptible, requires no dressing. Crosses show its extent.



*Late Result.*—The patient returned for an examination two months later, February, 1904. He was subjectively perfectly well and with no pains. No disability whatever was apparent from removal of the arches. He had gained eighteen pounds in weight, was back at work, "felt as strong as ever before." There was no difference in the appearance of the two hands, and the muscles seemed equally developed and supple. The hyperæsthesia of the fingers had gradually disappeared soon after leaving the hospital. Measurements of the arms showed only one centimetre in circumference throughout in favor of the right side. The only residual of his previous condition was in the slightly too great activity of the deep reflexes.

*Pathological Report.*—November 19. The tissue consists of an oval-shaped tumor broken in two portions, its upper pole, consisting of about one-third of the growth, being separate from the rest. In its original state it measured in the long axis about four centimetres. The growth has a smooth outline and a delicate capsule. It is soft, quite vascular, and the surface on section is moist and of a grayish-pink color.

*Microscopical Examination.*—The tumor is made up largely of connective-tissue elements, the cells being somewhat more numerous than seen in simple fibrous tissue. The growth is quite vascular, and there is considerable hyaline degeneration, chiefly distributed about the blood-vessels. It is impossible to say positively whether the growth should be classified as a fibroma or a sarcoma, a question which hinges entirely on malignancy, and which cannot consequently be determined by histological studies alone. Fibrosarcoma with hyaline degeneration.

There follows a bibliographical summary of the cases of intradural tumor which, from the double criterion of enucleability and of a more or less complete postoperative restoration of function in the compressed cord, have up to this time been successfully operated upon. They are arranged chronologically according to the dates of operation.

(1) GOWERS AND HORSLEY. (Royal Medical and Chirurgical Society. January 24, 1888; also "Ein Fall von Rückenmarksgeschwulst mit Heilung durch Extirpation." Uebersetzt u. s. w. von Dr. Bernhard Brandis. Aug. Hirschwald, Berlin, 1899.)

An intradural fibromyxoma of the upper thoracic region (3-4) was removed by Horsley, June 9, 1887, from a patient, male, aged forty-two years, who after three years of symptoms had become completely paraplegic, presenting all the indications of a total transverse lesion of the cord.

Ten days after the operation sensation began to return in the lower extremities and slight voluntary movements in two weeks. A slow but uninterrupted improvement followed, and a year later, June 6, 1888, he was practically well, though with some residual disturbances.

(2) \* ESKRIDGE AND FREEMAN. ("Intradural Spinal Tumor opposite the Body of the Fourth Dorsal Vertebra; Complete Paralysis of the Parts below the Lesion; Operation; Recovery, with Ability to Walk without Assistance within Three Months." *Philadelphia Medical Journal*, December 10, 1898, Vol. ii, p. 1236.)

On September 24, 1897, Freeman enucleated from the mid-thoracic region of a boy, aged twelve years, an intradural growth, designated as a "soft fibroma." This had given symptoms for a year, and had ultimately produced a marked degree of paralysis of both lower extremities. There was a rapid return of function in this case, improvement having been apparent almost immediately after the operation. Ultimate functional recovery of the cord (after some few months) was practically complete.

(3) FR. SCHULTZE. ("Ueber Diagnose und erfolgreiche Behandlung von Geschwülsten der Rückenmarkshäute." *Deutsche Zeitschrift für Nervenheilkunde*, 1900, Band, xvi, p. 114.)

Schede, February 6, 1899, removed from the lower thoracic cord (opposite the seventh vertebra) a subdural fibromyxoma. The patient, a young man aged twenty-eight, had had root pains for three years and almost complete spastic paralysis for six months. After a temporary postoperative increase in the degree of the palsy, he began slowly to improve; could walk without support in six months, and in 1902 (reported in *Mittheilungen a. d. Grenz d. Med. u. Chir.* 1903, Band xii, p. 156, Dritter Fall), when last examined, he was "vollkommen arbeitsfähig."

(4) PUTNAM AND WARREN. ("The Surgical Treatment of Tumors within the Spinal Canal." *American Journal of the Medical Sciences*, October, 1899, Vol. cxviii, p. 377.)

An intradural growth was removed by Dr. Warren, some months before the report (no date given), from the lower dorsal region of a woman fifty-two years of age. Symptoms had been present something over a year. The complete enucleation of the tumor in the case was

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\* A case, the original report of which I have been unable to find in the literature, has been handed down through several articles (Chipault, Bruns, Starr, Putnam, and Warren et al.) as appearing in the *New York Medical Record*, 1890, Vol. ii, p. 564. Roy is quoted as having removed from the lower dorsal region of a paraplegic patient an intradural tumor with operative recovery and ultimate ability "to walk with a cane." This case possibly should be included in the above series.

followed by a temporary postoperative increase in the pressure symptoms, and, though there was a slow subsequent improvement in her condition which promised ultimate betterment, restoration of function was incomplete at the time of the report.

(5) HENSCHEN AND LENNANDER. ("Rückenmarkstumor, mit Erfolg extirpiert." *Mittheilungen a. d. Grenz. d. Med. u. Chir.*, 1902, Band x, p. 673.)

An intradural fibrosarcoma compressing the lower cervical cord was removed by Lennander, February 8, 1900, from a man, aged fifty, in whom root symptoms had first appeared two years before. Pressure symptoms had been present for about a year and had advanced considerably beyond the Brown-Sequard type, and the patient was bedridden. Improvement in the cord symptoms began immediately after the operation, and by October 23 (eight months) the recovery was practically complete.

(6) FR. SCHULTZE. "Zur Diagnostik und operativen Behandlung der Rückenmarkshantgeschwülste." *Mittheilungen a. d. Grenzgebieten d. Med. u. Chir.*, 1903, Band xii, p. 158 (Fünfter Fall).

Schede enucleated, December 12, 1900, at the mid-thoracic level a subdural "spindle-celled sarcoma." The patient, a young man, aged twenty-four, had had root pains for eight months and symptoms of pressure on the cord for four months. The convalescence, unfortunately, was complicated by an acute infective meningitis. After a year or more (1902) there was practically complete restitution of function, aside from some overactivity of the deep reflexes and the fact that he was easily fatigued.

(7) FEDOR KRAUSE. ("Zur Segmentdiagnose der Rückenmarksgeschwülste, nebst einem neuen durch Operation geheilten Fall." *Berliner klinische Wochenschrift*, 1901, Band xxxviii, pp. 541, 583, 604.)

A small intradural but adherent psammoma of the lower dorsal region was removed, June 18, 1900, from a woman aged sixty-five. A year later some slight improvement in motor and sensory symptoms had taken place.

Boettinger made a second report of this case (*Archiv. f. Psychiatrie*, 1901, Band xxxv, p. 83) which seemingly has led to its being doubly entered in some of the collected lists of tumors of the cord. Compare Collins's recent exhaustive tabulation.

(8) OFFENHEIM. ("Ueber einen Operativ behandelten Fall von Rückenmarkstumor." *Berliner klinische Wochenschrift*, 1902, p. 905.)

An intradural fibroma, compressing the lower thoracic cord, was removed by Sonnenberg, April 21, 1902.

The patient was a young woman of eighteen years, in whom symptoms had been present for only six to eight months, but had led to an early condition of spastic paresis with sensory disturbances in both lower extremities. A month after the operation, the first attempt was made to walk; and a month later she had so far improved as to walk faultlessly, and only the slightest evidence of the original pressure symptoms remained.

(9) PUTNAM, KRAUSS, AND PARK. ("Sarcoma of the Third Cervical Segment; Operation; Removal; Continued Improvement." *American Journal of the Medical Sciences*, January, 1903, Vol. exxv, p. 1.)

An intradural "sarcoma of the round-celled type" was removed from the upper cervical region by Park, April 28, 1902. The patient, male, aged forty-five years, had had symptoms for two years, and was bedridden from a nearly complete paraplegia. When reported, six months later, considerable improvement in the pressure symptoms had already taken place, though a residual palsy of the crossed (Brown-Sequard) type still persisted.\*

(10) PRESENT CASE.—An intradural fibrosarcoma compressing the lower cervical cord was removed by the writer, November 19, 1903, from a man, aged thirty, in whom root symptoms had first appeared eighteen months before. Evidences of compression of the cord had been present for about six months, and had not quite advanced to the Brown-Sequard type of hemileSION; the patient was able to move about with a dragging foot. Improvement in the cord symptoms began immediately after the operation, and by February 20, 1904 (three months) or earlier there was no trace of the palsy observable, and the patient had returned to his former occupation.

This case and Case 5 are almost the exact counterpart of one another, differing only in the circumstance that Lennander's had progressed six months longer. The development of symptoms as far as they went was equally rapid in the two cases, and the growth presumably enlarged at a corresponding rate in both.

There have been several instances other than those mentioned above in which an intradural growth has been accurately diagnosed, localized, exposed at operation and removed, unfortunately, however, with a lethal result. There have been also cases in which an enucleable growth, which the operation failed to expose, has been demonstrated at autopsy; others as well in which a growth has been encountered and enucleated

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\* This case is especially noteworthy as being the highest placed growth to have been successfully enucleated. Other higher ones have been attacked and partially removed with betterment of symptoms. The writer has personally had one case of meningeal sarcoma (pial?) originating from the bulbar meninges and projecting into the posterior fossa of the skull under the cerebellum. The occipital base, including the posterior half of the foramen magnum, was removed in this patient and the largest part of the growth enucleated. It so surrounded the bulb, although unattached and non-infiltrating, that the operation was abandoned. The child is much improved, and, though alaxic, seems to be temporarily "well" at the present time, six months later.



without subsequent restoration of function in the cord, whether from operative injury or from prolonged compression effects that have led to an irrecoverable condition of softening. These cases have not been included in the above list, nor have the more numerous instances of extradural growths that have oftentimes been operated upon with a greater or less measure of success. With few exceptions, notably one of Schede's cases in which an extradural fibroma was enucleated, the latter are infiltrating tumors which by extension into the spinal canal have ultimately led to pressure symptoms\*. The intradural tumors primarily of pachymeningeal origin form a group quite apart. They are enucleable growths, and, were it not for their chance situation, with the severe pain they occasion and the ultimate paraplegia, would be regarded as comparatively benign conditions.

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\* One such case from Dr. Osler's ward has recently been operated upon. An extradural metastatic(?) lymphosarcoma was removed from the mid-dorsal region of a negro after a few weeks of total paraplegia. There has been a steady improvement in symptoms and a promise of complete return of spinal function, though the ultimate prognosis necessarily is most unfavorable.